time, without any difficulty; and the same thing is true of hydrogen.

Now, I do not imagine, by any means, that these facts settle the question, or prove that CO_2 is the only normal stimulus to respiration; but I am sure that there is something in the contact of CO_2 with the mucous membrane, which produces an effect entirely different from that caused by other indifferent gases with the same membrane.

ART. III.—SPEECH AS A REFLEX ACT.—THE PHONO-MOTOR NERVOUS CENTRE.

BY DR. E. ONIMUS.

Translated from The Journal d'Anatomie et de Physiologie, 1873, 545-564.

THE importance of reflex action in all the phenomena of the nervous system, is to-day universally recognized. It may be said that it presides over all the functional manifestations. It is not necessary, in fact, to limit the designation reflex to those movements which the spinal cord can produce without the intervention of the brain; but in a general way we may consider those as reflex acts which are due to the transformation of a centripetal impression into a centrifugal reaction; no matter whether that change takes place in the cord or in the brain; whether the impression be central or peripheral; whether it proceed from a nerve of special sense, or a spinal sensory nerve; from ganglion cells, or from centres presiding over psychological phenomena. In a word, reflex acts of the most indisputable character may be recognized in the intellectual functions themselves; and we aim to show in this article the influence of this automatism on the function of speech.

It is necessary to first remark, at this point, that some reflex acts are very complex, and that they produce an assemblage of co-ordinated movements corresponding to a fixed purpose. We may, therefore, at this point, recall certain fundamental facts which we insisted upon in our paper on the "*Phenomena Following the Removal of the Brain.*" (*Journal d' Anatomie et de Physiologie*, Nov. 1870–1.)

Reflex acts take place from all sections of the cord, from all groups of nerve cells, from a ganglion, for example; but in proportion as the central nerve mass is large, they take on special characters.

When the cord is severed low down, only a movement limited to the limbs can be brought about; but little by little, as it is cut higher up towards the encephalon, the motions become more extensive. Finally, when the cerebral lobes themselves are alone destroyed, no reflex act limited to one member is seen; and any excitation whatever causes a general movement, which in animals is exhibited in the movements of locomotion, leaping, swimming, or flight.

When the cord is separated from the brain at a point below the medulla oblongata, general movements (leaping or natation of the frog, for example) are impossible; and in this case the reflex movements are always proportional to the energy of the excitation. But when the cerebral lobes only are removed, the case is different; whether the excitation is powerful, or the reverse, the movements which follow it are always movements of the whole body. We may remark here, that the removal of the cerebral lobes does not cause any of the motions of the uninjured animal to cease; these occur with even more regularity than before; we might almost say that they take place more normally than in the normal condition.

On the other hand, these movements follow inevitably; it seems to be impossible to avoid them. It is as if the frog, deprived of its cerebral lobes, and put in the water, is compelled to swim; or the pigeon, without its brain, and thrown into the air, is obliged to fly.

We may conclude from these facts that the general movements of the whole body are produced by certain special nervous centres, situated outside of the brain, although in the encephalic region; centres independent of the will as regards mechanism, but which are essentially passive, and which do not enter into action except as incited from the brain, or by peripheral irritation.

We ought not, therefore, to recognize in all the habitual and voluntary movements a direct action from the brain on each muscle; and we are compelled to acknowledge that there exists, outside of the brain, centres for movements which serve as intermediators between the will and external acts. The brain sends, so to speak, the general order for the execution of such and such motions; and it is these co-ordinating centres and directors of muscular action that are charged with the details of the functional act.

Further, as we have already stated above, these automatic movements have a precision, a perfection, that those over which the will has a constant and direct supervision do not invariably possess.

We have distinguished two classes of these general movements produced by these locomotor centres, and apart from any direct influence of the brain; the first comprises the instinctive acts, such as those of flight in birds, and of swimming in ducks (we have observed that young ducks, raised by a hen, which have never before been in the water, and from which we had taken the cerebral hemispheres, immediately began to swim when placed in the water). The second class includes all those movements of the body which are only met with in adult animals; which we have called reflexes of habit or education; such, for example, is the habit of the pigeon in putting its head under its wing when it sleeps, or the motion of picking and smoothing its plumage. We have never observed these acts in young pigeons after removal of the brain, while in old birds this habitual act continued to be performed subsequent to the operation. We see in this instance, therefore, a striking exemplification of the influence of habit on the automatic acts.

Finally, organic or physiological modifications of the system, when they are not merely temporary ones, act equally on the general reflex movements. For instance, if a male frog is decapitated in its season of copulation, and is then excited, movements of the anterior limbs, such as are made when embracing the female, are provoked.

It is true, then, that the co-ordinated and automatic movements of instinct or education, and those coincident with a temporarily exaggerated function, exist unimpaired after the removal of the brain. It is then correct to say that, in the normal condition, they are effected by the same mechanism, and that the will has only an excitant and directing influence over them.

That which is true of the general movements belonging to the other principal functions, appears to us equally true for the function of language, for which we believe we can establish a centre which presides, independently of the will, over the acts of phonation. To be sure, the question in this case becomes more complex, because the nerves producing the impression are no longer sensitive nerves; and it is impossible to establish, *experimentally*, the independence of this centre, to which we propose to give the name *phono-motor*.

It is necessary, nevertheless, to remark that the locomotor centres themselves do not invariably require a peripheral excitation, or the action of spinal sensory nerves, to cause them to enter into activity.

Also, it would be difficult to specify what sensory nerves act in the case, when an animal without a brain seeks to maintain its equilibrium; or by what peripheral action a pigeon, in like condition, invariably exerts itself to fly when thrown into the air. There is to be seen, also, in many cases where the reflex action is incontestable, a mechanism which is located in the central regions of the nervous centres, and where the existing impression comes from a kind of memory or reminiscence of previous ones. The word memory, in this sense, evidently signifies an impregnation of anterior impressions; and the phenomenon is in itself the same for the sensory cellules as that which takes place in the cells of the brain.

The general movements, and particularly those of education, have, as an element of co-ordination, that unconscious memory which is nothing else than an oft-repeated impression, which reacts on the motor cells, regulating and proportioning the muscular activity. Having been excited an incalculable number of times, in a certain manner, the same cell reacts again in a similar fashion to a like impression, even when the will and the intelligence are abolished. It is by this mechanism that we can explain the more complicated reflex acts, and those which take place without peripheral excitation.

Among the superior animals the reflex movements of instinct are much less numerous than among the lower ones; but those of habit or education, on the other hand, exist in great number; and it is a mistake that they have not been for so long a time attributed to the same mechanism as the others; for, if the automatism does not predominate in all, we may be assured that it exists as a fundamental and necessary fact.

As regards speech, in which we believe we have discovered all the characters of the reflexes of education, the combined actions only become developed little by little, and by a long and difficult education; but it is absolutely the same method of procedure as for other more simple complex movements: such as those of locomotion. The first acts are simple, limited, and still inco-ordinated; and gradually, in proportion as they are often repeated, they become more regular and extended, and it is only after each simple movement has become perfect that the more complex ones begin, at first indecisive, then co-ordinate and regular.

Plutarch has made the remark that the first articulate sound pronounced by man is that of the letter *a*, because the *souffle* which leaves the mouth by the mere opening of the lips is the first simple sound, and needs no other instrument, not even requiring the use of the tongue for its production. After this, follow words a little more complex, and requiring the use of many different muscles. President De Brosse, in his *Traite de la Formation Mecanique des Langues*, 1765, is one of the first who has correctly analyzed the physiological development of language. "The germs of speech," says he, "or the inflexions of the human voice, which include all the words of a language, are physical and necessary effects, resulting absolutely, such as they are, from the construction of the vocal organs. Human speech, and the forms of the names of objects, are not, as much as they seem, the arbitrary product of the human will. In the first formation of language and of radical terms, the form is the necessary effect of the sensations derived from external objects; and the will exercises scarcely any influence."

It is a noteworthy fact that, in all languages, the syllables *ab*, *pa*, *am*, *ma*, are the first pronounced by children; that is to say, they commence by using their lips, all these syllables being labials. We think that the explanation of this fact is to be found in the great facility that they have of controlling the movements of their lips, since they contain the voluntary muscles which are the first and most frequently put in action by the act of sucking.

We see, therefore, that the phenomena of the exterior movements of speech are ruled by the same laws as those of locomotion, of swimming, or of those which need the play of any instrument whatever.

The education is accomplished in proceeding from the simple to the complex at the time when, by this series of efforts, it forms, through habit, a kind of memory which regulates and co-ordinates the muscular action, and causes it to take instantly the energy and direction desired.

In the adult, the phenomena which attend the function of speech are so complicated that it is difficult to recognize the automatic actions; so much the more as speech, serving to manifest our ideas, appears constantly to be the effect of a voluntary and intellectual act. But in certain pathological conditions, and even in some normal ones, we find plain proofs of a purely reflex action, at least a kind of automatic mechanism, through which the sensations perceived have a more direct influence, and often a more powerful action, than the will.

Let us first examine some of the instances which occur normally, and especially the influence that can be exerted on the memory of words, and consequently on the function of speech, by the sense of hearing, that one, of all the special senses, which most acts to create that function.

When we observe what takes place during an oral recitation, especially by children, we can very well see, in nearly all cases, that it is not the expression of the idea which causes the words, but rather the habitude, from having repeated many times the same sounds in the same order. One word causes another, because the aim has been to retain one after another by the succession of sounds. It is for this reason that we are able to retain a more exact verbal memory of verse than of prose: because we have in this case, besides the order of the words, the rhythm of the poetry. So with most persons when they have stopped short in the middle of a paragraph, or especially of a verse of poetry, it is often necessary, in order to recall the part forgotten, to go back to the beginning of the verse, or even to repeat the preceding series, and to profit by the cadence and the rhyme.

Often, again, when the word which the mind endeavors to recall is not distinctly understood, the vague, unintelligible sound will recall it to the memory. This phenomenon takes place nearly always when the prompter is a little distance off, and is understood, so to speak, only by the person reciting, when others near at hand only hear a confused sound. There is certainly in this case an unconscious action, in which the intellect has no part, and in which the sense of hearing acts in an automatic manner.

Laplace, in his *Essai Philosophique sur les Probabilities*, cites the following fact: "One day, as a merchant of Paris was walking the streets of St. Germain, reflecting on some important matters, he found himself unable to refrain from humming, in a very low tone, as he walked the street, the air of an old song which he had forgotten for many years. Some two hundred steps farther on, he began to hear an old blind man playing, in the public place, the same air on his violin, and he imagined that it was a slight perception, a *semi*-perception, of the sound of the instrument, enfeebled by the distance, that had come to his organs with the strain, in a manner insensible to himself.

"He declared that, since that time, he had often given himself the pleasure to suggest such airs as he pleased to a roomful of working girls, without their being able to hear him. Whenever he ceased to hear them sing for a moment, he began to hum, in a very low tone, the tune he wished them to sing; and it scarcely ever failed to reach them without their sensibly hearing him, or any suspecting the cause of its suggestion to them."

So, from the intonation of the first part of a word or paragraph, we often recall the whole. In this respect children are very interesting subjects for study, for as the exact word is recalled by this procedure, they pronounce it very rapidly, as if it might again escape them; as in certain aphasic persons a word is uttered with energy, and, an instant later, they are often unable to pronounce it.

In the case of an aphasic patient whom we have had occasion to observe, we have often tried this experiment of intonation, in order to make him name an object. Nearly always, by giving him the first part he would be able to pronounce the entire word. One day I showed him a statuette, and asked him the name of that object. As he was unable to recall the right word, I thought I could make him do so by pronouncing the syllable *sta*, the first part of the word statuette. I repeated *sta* three or four times; but he could not recall the word; and it was only when his wife, who accompanied and took care of him, said to him, "It is an es - - -," that he found the name, and said, "It is an estatue." I had forgotten that, in common language, it is usual to say, *une estatue*, and not *une statue*; and I only cite this instance because it indicates so well how the first intonation recalls the forgotten word.

One of the facts which prove the automatism which exists in the function of language, is the difficulty we often meet with in refraining from habitual expressions. So, in joy, in anger, or in sudden pain, while the intelligence fails to control our speech, and the volition is distracted, there escape, in spite of us, oaths and ill-sounding words: at least, this happens, almost constantly, among those who are in the habit of employing such expressions when under no social restraint. We can almost compare the *tics* of speech to muscular *tics*, in the case of those who are in the habit of swearing, or of using certain expressions.

On the other hand, how as regards common expressions, from which we seek to refrain when they express the contrary of our thought? How many persons are there who have found themselves automatically responding that they are well, to the usual question, "How do you do?" when, on the contrary, they are not well, and are obliged to take back and rectify their response.

These phenomena are often very noticeable among the subjects of aphasia; and M. Moreau (of Tours) has observed that some of them are still able to reply to a question, and yet are immediately after incapable of repeating the same words. You give them a word and they cannot repeat it; but you ask them a question, the answer to which requires that word, and they reply readily. For example, they are asked, "How goes it?" and they reply, "It goes very well." Re peat the words, "It goes very well." They endeavor in vain to pronounce that phrase; they become impatient and irritated at their failure, but without result.

M. Broca has also remarked that certain subjects of aphasia who are unable to pronounce substantives, do so readily when they are intercalated with other words, or in the middle of a rapid speech, or an oath.

All these facts seem to me to demonstrate very evidently that there is in the function of language, in certain normal conditions, a true automatism, which is produced by education, and which in its processes resembles the automatic functions of other organs.

If, from the normal condition we pass to those which arise from pathological alterations of the organs of phonation, we observe much more clearly the resemblance which we seek to establish between the locomotor centres and a phono-motor centre.

Those who have in part lost the faculty of speech, afford us some remarkable examples in regard to this point, as has been already stated by M. Luys; that it seems, in certain patients, the way being all marked out across their brains, the word reaches it, and leaves automatically, under the least excitation. Allow us to give, in this place, one of our own observations bearing on this point:

Victor Prince, an employe of the Suez Canal Company, aged fifty-eight years, following a short loss of consciousness, was temporarily paralyzed in the right arm, and lost the use of words. The arm recovered its movements the same day, while speech was completely lost for eight days. The first word he was able to say, was *oui*, followed by oaths. Gradually he began to pronounce some words, without being able to carry on a connected conversation; and it was very seldom that he was able to find the exact word he wanted.

Intelligence was perfectly preserved, and he very evidently retained the memory of places and facts. He sang readily a couplet of the *Chant du Depart*, and the song of the *Bœufs*, of Pierre Dupont; but when I wished to make him repeat the verse slowly, he failed, and could not recover the words.

If I interrupted him after repeating two or three lines, he could not continue, but was obliged to recommence the couplet. He could not pronounce separately the words he sang. As regards figures, he very readily repeated, one, two, three, four, etc., in their natural succession; but if asked to pronounce them in pairs, he found it impossible. After two, or after four, he always gave three or five, although conscious of his error. The same happened in reading the numbers: he read them very well in their regular order, as, for instance, four, five, six; but could not do so when they were otherwise arranged, as four, one, nine. He could make additions mentally, but when he came to write down the figures he did it wrong.

Sometimes, after he had been compelled to exert himself for a long time to recall the exact word or figure which he found it difficult to enunciate, he afterward repeated it very often, and in the place of other words or figures. We might say that the effort had left, for a time, its impression.

He could only read a few words aloud; but he read mentally with facility. When he read aloud, he often substituted for the word before him another commencing with the same syllable. For instance: instead of the word *medical*, he would read *meridional;* in the place of *physiologie*, he read *physique*. He could not write that which he was able to speak—not even the couplets of verse which he recited—but he could copy them. The only words he could write without having the copy before him were *Paris*, and his own name. When he tried to write a couplet of the *Chant du Depart*, out of all the fifteen times that I made him attempt it, in only four did he make any exact approach to the first words; but generally, afterwards, the words were badly written, and finally completely indecipherable. In the different specimens of the handwriting of aphasic patients, collected by Dr. Proust

(*Archives Generales de Medicine*, 1872), we also observe that only the first words and the monosyllables are correctly written.

We give here an example of the writing of our patient:

> " *La vitore en tanfant nous hour la bariliere*
> *La viverte la limite nige non* pas
> *Et du nours four nasei la frandite* fergiere
> *La nonterie gourere la saurne lur fictus du* coupat
> *Tranto nendimi de la* Fances "

We may notice in these first lines some traces of the stanza:

> " *La victoire en chantant nous ouvre la carriere,*
> *La Liberte guide nos pas*
> *Et du nord au midi la trompette guerriere,*
> *A sonne l' heure du combat.*
> *Tremblez, ennemis de la France,*" *etc.*

That which strikes us in these lines, is that the intonation of the rhymes still exists in the disfigured words; and this only confirms that which we have said already in regard to the memory of poetry. We see, also, in many of the words, a similarity of sound which approaches the exact word.

We would remark, still, that when we insisted that he should correct a word wrongly written, he much more readily wrote it right by commencing to write the whole word in one trace, than by trying to correct it as written.

Do not we often find, among healthy persons, that if they are unable to recollect the exact orthography of a word, they can write it mechanically, and, when done, it is rather the result of mechanism than of an orthography controlled by reason?

We know that, among aphasics, one word often necessitates another, when this last is ordinarily used with the other. The same holds good in their writing; at least in the case we report.

One stroke necessitates another, so to speak; for when they are made to write the same letters many times, they have the tendency to always put them one after another. For instance: when I made the aphasic patient whom I have described to write the word *chose* a number of times, and then told him to write *coquin*, he wrote *cho . . .;* and in this case *ch* only formed, so to speak, one letter. An instant afterwards, I made him write the word *concorde* a number of times, and then told him to write *coquin:* he wrote, correctly, *co.* I then made him write *chose:* on the first trial he made it *cohse;* and on the second, after I had called his attention to his mistake, he wrote it *chonse.* We observe, in this last orthography, the *n* of the first syllable of *concorde.*

We see, in these instances, how an act often repeated previously can influence the writing; and how, in all these phenomena, there exists a reflex action as manifest as in certain movements of the limbs.

In studying the majority of the observations on aphasia, we find related phenomena of the same kind as those we have cited above, which also confirm the position we have taken.

For instance: what more striking example of the automatic succession of sounds or syllables is to be found than that given by Trousseau, in the case of a patient who often repeated *consisi*, but could never pronounce the syllables *si*, *si*, and only with great difficulty, *con?* We notice, in this case, that the patient, in giving the first part, had great difficulty in limiting his speech, and was, in a manner, compelled to give the whole word; while he was absolutely unable to pronounce the last syllable, except as a reflex effect of the first, the prior impression being a necessity. Another aphasic patient could say *bon-jour*, but could never utter the word *bon.*

We equally observe this automatic influence in an observation of Franck, who gives the example of a Polish lady, who, whenever she wished to say "*Yaka dobra*," (How good you are) said "*Yaka durna*," which signifies, How *bad* you are.* In this case we discover, further, what is quite frequent among aphasics, a marked tendency to say or write, regularly, the first word or first syllable, while the following ones are incoherent. †

The facts we have given suffice, we believe, to demonstrate that there exists in the function of language, reflex action, as well defined as in any of the other functions.

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* See, for further details, the excellent paper of Dr. Proust (*Archives Generales de Medicine*, 1872.)

† As we write these lines, we have under observation the case of an aphasic who can repeat, with sufficient ease, the words *Champs Elysees*, but

If we now apply to this function the laws which we know exist, in a certain manner, for the other nervous centres, we shall admit that there exists, for the function of speech, a co-ordinating centre, which presides over the complicated movements involved in the act. The will only gives the order, and this phono-motor centre carries it out according to its means and conditions. The movements are co-ordinated and complete if the organ is in a healthy condition, and incoordinate and incomplete if it is otherwise.

In a word, as we are obliged to distinguish for each movement of a member (1. The simple and limited reflex action; 2. The more complex reflex actions, producing a general movement; 3. The influence of the will), so, in the case of the motions involved in the utterance of words, we have to distinguish the isolated movements of each separate part, the movement of the whole, and the influence exercised by volition. One can, in this manner, understand how loss of speech may result from diverse lesions.

In pathological conditions of the ordinary movements we find different phenomena, as the lesion bears on one or the other of these systems. If the lesion is situated in the spinal canal, voluntary motion is abolished; but certain simple reflex acts are still produced. If it is in the locomotor centre, the movements are ataxic, choreic, incomplete, and are constantly and forcibly produced. Finally, if the lesion is situated in the brain, the general movements may be regular, but the will does not act any more to produce them. As the locomotor centres belong to the essentially passive organs, the movements can only be induced by some peripheral excitation, or, in rare cases, by the will, when the brain still has power to transmit a part of its action. In this respect, nothing appears to us to correspond better with the function of speech than the play and the movements of the fingers of a musician (a pianist, for example); and this comparison seems to us all the more true, as the fingers of the musician act to display his feelings

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cannot say *Elysees;* he also repeats the words, *Bois de Boulogne*, while he says *Boulogne* with great difficulty, and only when, instead of being asked to pronounce the last word of *Bois de Boulogne*, he is requested to give the name of the city of Boulogne.

and his musical memories, in the same manner as the vocal organs express our thoughts and recollections to those about us. In the case of the musician, also, the habitude of the fingers is only acquired slowly, by education; and the finger becomes merely a mechanism, with which the mind does not occupy itself. The playing appears the more natural, as the player leaves its direction to his feelings and habits.

Then, when a musical note escapes his memory, he recovers it by going over the preceding ones. In this case of the memory of the notes, as in that of the recollection of words, it is recalled by a kind of excitation of continuity and impulse.

The loss of the faculty of musical expression may depend on various causes; but they all are included under the three heads we have given above. It may be due to a lesion of the peripheral nerves, or of the spinal centre, producing a difficulty or a complete loss of power to execute the necessary movements. In the second place, there may be a disturbance in the locomotor centre, which may cause inco-ordination, or complete abolition of movement. In these two cases, the musical feeling still exists, but its external manifestation is abolished; the intelligence remains intact, but its instrument is defective. When, on the other hand, the brain only is injured, the instrument is perfect, but cannot be used.

The loss of speech also comes under these three categories, because it follows, 1. The alterations in the external organs; 2. To alterations of the phono-motor centre; and 3. To intellectual disturbances. The first and third cases are so evident, and so easy to understand, that we need not dwell on them here; but we will occupy ourselves a little more fully with the alterations of the phono-motor centre, which presents absolutely the same phenomena as those to be observed in the locomotor centres.* Therefore, as the pathological modifications of the different combined movements can be divided into two great classes, the ataxies and the paralyses, we can also include in these two divisions all the alterations of speech which do not depend on an intellectual disturbance or a lesion of the external organs. In fact, in all the observations of aphasics which have been cited, one or the other of these kinds of symptoms is presented.

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* All the divisions which have been proposed for the different cases of loss of speech are included in the classification which we adopt; it has, moreover, the great advantage of at the same time allowing the alterations of this function to be brought into the divisions admitted for the alterations of the other functions. In fact, for the functions of language, as for all the others, there is functional trouble when the external organs are affected, when its motor centre is disturbed, or, finally, when the brain itself is altered.

For example, as the musician who is troubled with choreic movements, and who wishes to touch a certain key, strikes that by its side, so the aphasic person uses one word for another, and cannot enunciate the exact one which expresses his idea. In the one case, as in the other, the alteration may be slight, and the first phrases are often perfect; but soon the inco-ordination appears, and augments as the patient makes

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The classification which we propose has yet the advantage of corresponding with the three successive acts which, together, form speech: 1. The idea is conceived; 2. It is reduced to the desired form to be transmitted to the exterior; 3. The vocal apparatus is put in motion, and the muscles of the larynx and the mouth produce our thought aloud.

M. Jaccoud has proposed the following classification:

1. Alalia by hebetude.
2. Alalia by verbal amnesia.
3. Alalia by interruption of voluntary transmission.
4. Alalia by default of co-ordination in the motor centre.
5. Alalia by paralysis of the tongue.

MM. Broca and Proust have classed the different losses of speech in the following mnaner: 1. Alogia; 2. Verbal amnesia; 3. Aphasia, or aphemia; 4. Mechanical alalia.

We would remark that, in this division, it is often quite difficult to separate, satisfactorily, verbal amnesia from aphasia; while, on the other hand, very different cases of aphasia are included in one class.

The classification which we would propose, as according with the anatomical and physiological facts, is as follows:

1. Cerebral alteration.
2. Alteration of the phono-motor centre, comprising two great classes: the one with ataxic, and the other with paralytic, symptoms.
3. Alteration of the external organs.

The first division comprehends alogia (Broca and Proust), and alalia by hebetude (Jaccoud).

The second includes verbal amnesia and aphasia (Broca and Proust), and the alalia by verbal amnesia—that by interruption of voluntary transmission, and that by default of co-ordination in the motor centre (Jaccoud).

Finally, the third class is the same with all the authors; and the name, *mechanical alalia*, is certainly well chosen, and ought to be kept.

the effort to avoid it. Often, also, as in the case of the choreic subject, who at the moment when he wishes to seize an object, lets it go, and it falls, the aphasic patient, likewise, after having found, for an instant, the word he wishes, loses it again, and cannot pronounce it, though he makes many vain efforts; or rather, still resembling the choreic patient, he utters brusquely a few words, and then stops short.

In all these cases there is to be found no lesion of a paralytic nature, but rather a defect of co-ordination. There is a disturbance of the phono-motor centre, which causes the ataxia of the vocal phenomena, analogous to that which a lesion, itself slight, of the locomotor centres causes in the movements.

In the second category we find the aphasias of the paralytic form. Some are, indeed, completely deprived of all power to emit articulate sounds; others can still pronounce some syllables, or some words, but always the same ones. Observations of this kind are numerous, and M. Broca, especially, has recorded many cases. One man could only say *tan, tan;* another, only yes and no; a patient of M. Charcot could only articulate the monosyllables *ta, ta;* others employed *bizarre* words without any signification. We have known the case of a very intelligent man who could only say *chaussette*, and who scandalized his confessor, to all of whose questions he responded by this single word.

M. Broca has compared these aphasics to infants who have not yet acquired, after infinite gropings, the very complex art of causing, by the combined action of a great number of muscles, the production and articulation of sounds; and in whom the faculty of speech, still in its budding state, only reveals itself by a series of monosyllables. We would prefer to make the comparison with certain cases of hemiplegia in which only very limited movements can be produced, always of the same kind.

Frequently, after a cerebral hæmorrhage, the only possible motion is the flexing of one or two fingers; and this takes place when the patient desires, on the contrary, to extend the hand. It is still this mere flexion that is produced whenever the patient desires to put his whole arm into motion, either by raising or by lowering it. In a word, the will has no further elective action; and to each effort, or to every intellectual excitation, there follows only this very limited and unvaried movement, no matter what the will had intended to produce.

So, in the case of the aphasic according to the extent of the lesion, he can only utter one, or a certain number, of words, invariably the same. He desires to express his ideas, but forcibly and inevitably, he always makes the same vocal movement; there is no inco-ordination, but a true paralysis, more or less complete, according to the case.

Nothing appears to us more logical than this assimilation of the vocal acts to the other complex muscular movements; and in admitting the existence of a phono-motor centre, as well as of locomotor centres, we believe that we need only review the theories so far proposed, adding some new physiological facts.

We would not say, therefore, that the will and the intelligence do not constantly intervene in the act of speech; but we have sought to show that there exists, in this function, besides the voluntary action, a kind of automatism which is the result of education; that this automatism possesses all the characters of those which exist in the other functions—characters which consist, principally, in a perfect condition, in a reflex and almost inevitable succession of phenomena which are associated from habit, and in a functional activity which derives from the will only a general excitation. In short, we believe that it is, in this respect, the same with language as with the movements of walking or dancing, or playing on an instrument.

The details of execution, their co-ordination, and their functional adaptation, are the result of the action of a special centre, which is only dependent on the will in a general manner, and which presides directly over all the phenomena—it might be called a superintendent or a register, who is charged with the overseeing that the orders are regularly carried out by all.

A great number of facts, well known to all, serve to confirm our view. Under many circumstances, in fact, words continue to be uttered while the mind is occupied with other ideas than those which are spoken at the time. Every one has spoken or answered mechanically when the thought was otherwise occupied. The actor, after a series of representations, scarcely occupies himself with that which he declaims; the child, who recites a fable for the hundredth time, plays and engages itself with other things. Outside of certain cases of cerebral affections, in which there is a true excitation of the phono-motor centre, are there not many who speak almost in a dormant state, as there are others who have continued to march while sleeping?

The orator speaks from intention, without doubt, but, by an abstraction which well indicates the division we have made, there are, so to speak, two persons combined in him—the one mechanical, which utters what he has before thought, and the other who at the same moment thinks what he is going to say next.

In the man who speaks in public, talent consists chiefly in his ability, either from natural aptitude or from education, to abstract himself from his language, and not to be disturbed in regard to the action of his phono-motor centre.

Following out the comparison given a little above, he has the advantage of a good superintendent, whom he may have found naturally to hand, or may have educated. He is, therefore, as if freed from all care of details; and while he speaks, he can employ himself, from the beginning, in giving his ideas, regulating and classifying them; while in the case of the man who is compelled to occupy himself both with the thoughts he wishes to express, and with the manner of their expression—who is forced, as they say, to seek for words—he is not master of his speech, and becomes embarrassed at the end of a very short time.

We might cite still other facts of this nature; but we believe that those we have produced will suffice to show how important a part the reflex acts play in the function of language. This automatism, created by habit and education, is to be found, moreover, in all the nervous centres; and we can, indeed, almost recognize them in the purely intellectual manifestations.

We find, in fact, in the intellectual acts, reflexes of instinct, of education, and of momentary excitation, of the same kind as the reflex actions of the exterior movements. We believe ourselves to be the masters of our thoughts and ideas; but they are often only the result of a kind of automatism of heredity, of education, or of momentary passion.

Habit exercises a special influence over our judgments, and they are often, like a reflex act, inevitable consequences of anterior impressions. One can predict, in persons the intellectual state of whom is known, as far as it is due to habit, the whole series of sentiments and volitions.

The processes of the functions of the nervous system are throughout the same; for even when they are of different orders and infinite variety, they are yet subject to the same laws; and among these, no one is of more importance than that of the reflex acts, which might be called the law of the physiological fatalities.

There might be added an important chapter on the automatism of the intellectual acts, which often controls us more than we imagine. Montaigne has said, "Custom is a violent and faithless school-mistress;" and Pascal has developed the idea well in a chapter in his *Pensees*, and we cannot afford better proofs than by quoting it. In this chapter, of which the title alone is to be remarked—"*It is difficult to demonstrate the existence of God by natural evidences: but it is most sure to faith*"—he expresses himself as addressing a sceptic. "You wish to come to the faith, and you do not know the road; you wish to be cured of your infidelity, and you demand a remedy. Learn it from those who have been such as you are, and who at present are free from doubts. They know the road you wish to follow; they have been cured of the disease of which you wish to be healed. Follow the way by which they began. *Imitate their external actions*, if you cannot yet enter into their interior dispositions.

"Leave off these vain amusements with which you are now wholly occupied. I would sooner leave them off, say you, if I had the faith. And I say to you that you would sooner have the faith if you would abandon these pleasures.

"It is not necessary to disown one's self; we are body as well as spirit; and from this it comes that the instrument by which the persuasion makes itself is not the only demonstration. How few things are demonstrated! The proofs only convince the mind; custom renders our proofs more strong. *It inclines the sense, which draws the spirit with it unconsciously.*

"It is necessary to acquire a more ready faith, which is that of habit; which, without violence, without art, without argument, makes us to believe the facts, and to devote all our powers to that belief, in such a manner as our mind *naturally takes.*"

We have only a word to add. If habit has such a powerful action on acts purely intellectual, it without a doubt has an incontestable influence on the phenomena in which intelligence less constantly intervenes, such as those of the vocal acts; and this is the point we have endeavored to prove in this memoir.

IV.—SOME REMARKS ON THE THEORY OF INHIBITORY OR REFLEX PARALYSIS.

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From the Practitioner.

In the *British Medical Journal*, 1874, I., p. 40, the following passage occurs in a highly interesting lecture on diabetes, by Dr. L. Brunton: "The second way in which the hepatic vessels may be dilated is by reflex paralysis, or inhibition, as it is generally termed, of their vaso-motor nerves. Every one knows that when a sensory nerve is irritated, the impression is transmitted to the vaso-motor centre, and arrests its usual action over the vessels of the part to which the sensory nerve is distributed. Thus, when a grain of sand falls into the eye, the irritation which it occasions to the sensory nerves of the conjunctiva is conveyed by them to the vaso-motor centre, and arrests the action of that part of it which